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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	HES 98.0078U1
First Inventor or Application Identifier	Harold O. Treece
Title	Univeral Cementing Plug
Express Mail Label No.	EI731576928US

jc549 U.S. PTO 09/175564 10/20/98

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)* *(Submit an original and a duplicate for fee processing)*
2. [X] Specification [Total Pages 28] *(preferred arrangement set forth below)*
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 2]
4. Oath or Declaration [Total Pages]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d)) *(for continuation/divisional with Box 17 completed)* ***[Note Box 5 below]***
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).
5. [ ] Incorporation By Reference *(useable if Box 4b is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. [ ] Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [X] Assignment Papers (cover sheet & document(s))
9. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
10. [ ] English Translation Document *(if applicable)*
11. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of IDS Citations
12. [ ] Preliminary Amendment
13. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
14. [ ] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [X] Other: Express Mail Certificate

NOTE FOR ITEMS 1 & 14: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

17. **If a CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: _____/_____

Prior application information: Examiner _____ Group / Art Unit: _____

18. CORRESPONDENCE ADDRESS

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Signature	Craig W. Roddy	Date	10/20/98

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FEE TRANSMITTAL

Patent fees are subject to annual revision on October 1. These are the fees effective October 1, 1997. Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid. See Forms PTO/SB/09-12. See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT ($) 1460.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Harold O. Treece
Examiner Name	
Group / Art Unit	
Attorney Docket No.	HES 98.0078U1

METHOD OF PAYMENT (check one)

1. [X] The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 08-0300

Deposit Account Name:

[ ] Charge Any Additional Fee Required Under 37 C.F.R. §§ 1.16 and 1.17

[ ] Charge the Issue Fee Set in 37 C.F.R. § 1.18 at the Mailing of the Notice of Allowance

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	790	201	395	Utility filing fee	790
106	330	206	165	Design filing fee	
107	540	207	270	Plant filing fee	
108	790	208	395	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 790.00

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims	43	-20** =	23	X	22	=	506
Independent Claims	5	- 3** =	2	X	82	=	164
Multiple Dependent						=	

***or number previously paid, if greater; For Reissues, see below*

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	22	203	11	Claims in excess of 20
102	82	202	41	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	82	209	41	** Reissue independent claims over original patent
110	22	210	11	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 670

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	950	217	475	Extension for reply within third month	
118	1,510	218	755	Extension for reply within fourth month	
128	2,060	228	1,030	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,320	241	660	Petition to revive - unintentional	
142	1,320	242	660	Utility issue fee (or reissue)	
143	450	243	225	Design issue fee	
144	670	244	335	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	790	246	395	Filing a submission after final rejection (37 CFR 1.129(a))	
149	790	249	395	For each additional invention to be examined (37 CFR 1.129(b))	

Other fee (specify) ______________________

Other fee (specify) ______________________

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 0.00

SUBMITTED BY				Complete (if applicable)	
Typed or Printed Name	Craig W. Roddy			Reg. Number	36,256
Signature	Craig W. Roddy	Date	10/20/98	Deposit Account User ID	

Practitioner's Docket No. HES 98.0078U1 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Harold O. Treece
Serial No.: 0 / unknown **Group No.:** unknown
Filed: concurrently herewith **Examiner:** unknown
For: Universal Cementing Plug

Assistant Commissioner for Patents
Washington, D.C. 20231

EXPRESS MAIL CERTIFICATE

"Express Mail" label number EI 731576928US

Date of Deposit October 20, 1998

I hereby state that the following *attached* paper or fee

Specification with 43 pages
2 sheets of drawings
Declaration and Power of Attorney
Assignment with recordal sheet
Information Disclosure Statement, PTO-1449 & References
Patent Application Transmittal
Fee Transmittal
Return Receipt Postcard

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10, on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Craig W. Roddy

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Craig W. Roddy

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NOTE: ***The label number need not be placed on each page. It should, however, be placed on the first page of each separate document, such as, a new application, amendment, assignment, and transmittal letter for a fee, along with the certificate of mailing by "Express Mail." Although the label number may be on checks, such a practice is not required. In order not to deface formal drawings it is suggested that the label number be placed on the back of each formal drawing or the drawings be accompanied by a set of informal drawings on which the label number is placed.***

(Express Mail Certificate [8-3])

PATENT
HES 98.0078

UNIVERSAL CEMENTING PLUG

BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to cementing plugs for use in cementing casing in a well, and more particularly, to a universal cementing plug having improved wiping and extended wear and which includes a plurality of interchangeable inserts so that the plug may be selectively used as a top or a bottom plug.

2. Description Of The Prior Art

In the process of preparing a well for testing and/or production, a casing is positioned in the well and cemented in place. Typically, at the beginning of the cementing job in rotary-drilled wells, the casing and the wellbore are usually filled with drilling mud. In many areas, to reduce contamination on the interface between the mud and cement a bottom plug is released from a plug container and pumped ahead of the cement slurry. Such plugs have wipers of an elastomeric material thereon to wipe the casing of any accumulated mud film so that the mud is pushed ahead of the bottom plug.

When the bottom plug reaches floating equipment such as a float collar or float shoe at the bottom of the casing string, a fluid pressure differential created across the plug

ruptures a rubber diaphragm at the top of the plug and allows the cement slurry to proceed down the casing through the plug and floating equipment and then up an annulus space defined between the casing and the wellbore.

When all of the cement has been mixed and pumped into the casing string, a top cementing plug is released from the plug container. The top plug also has wipers of elastomeric material thereon. The function of the top plug is to follow the cement and wipe any accumulated cement film from the inside of the casing. The top plug is also designed to reduce the possibility of any contamination or channeling of the cement slurry with the drilling mud that is used to displace the cement column down the casing and into the annular space between the casing and the wellbore. The top cementing plug is typically solid in construction, and the design is such that when it reaches the bottom cementing plug at the float collar or float shoe, the top cementing plug causes a shutoff of fluids being pumped into the casing. This causes a normal pressure rise at the surface and notifies the operator that the cementing job is complete.

The landing of the top plug lessens the possibility of any further displacement of the cement slurry and provides a better quality of cement slurry around the bottom of the casing where a good cement bond to the casing is required.

Currently, two different cementing plugs are used in this cementing operation, one for the top and one for the

bottom. The bottom plug has a shearable member, such as the rubber diaphragm previously mentioned, which shears when a specific fluid pressure differential is applied thereto. The top plug is substantially solid. Because each plug requires different construction, separate molds must be used for each of the plugs which increase the costs of manufacturing, and also, the two separate plugs must be kept in inventory. The present invention solves this problem by using a single plug subassembly design which has the same general construction whether it is used as a top plug or a bottom plug. A shearable insert is positioned in one plug so that it may be used as a bottom plug. This shearable member is designed to shear at a predetermined differential pressure thereacross. In one embodiment, the shearable member is a flat disc, and in another embodiment, the shearable member has a relatively thin domed portion. Another insert, which is essentially non-shearable at the pressures in which the plugs are utilized, is positioned in another plug so that it can be used as a top plug. By the use of a single plug subassembly, with separate inserts, the cost of molds of the plugs is decreased, and only one plug must be maintained in inventory along with the different inserts.

Another advantage of the present invention is that the shearable member may be interchanged with a plurality of shearable members, including, but not limited to, the two embodiments previously described, designed to shear at any

one of a selected number of differential pressures as necessary for different well conditions. This is an improvement over the previous design which had essentially one shear pressure.

With prior art cementing plugs, the wiping efficiency of the wipers on the plugs is affected by pumping rate and wear along the casing surface. The cementing plug of the present invention provides an improved wiper design which offers more surface contact, and as the plug is pumped down the casing, wiping efficiency is increased. As a top cup on the plug wears, the pressure is transferred to a bottom cup which prolongs the surface engagement maintaining the wiping, resulting in extended wear.

SUMMARY OF THE INVENTION

The present invention is a universal cementing plug which may be configured as either a bottom cementing plug or a top cementing plug. The plug may also be described as an improved wiping and/or extended wear plug.

The cementing plug is adapted for use in cementing casing in a well and comprises a body member defining a central opening therethrough, an elastomeric jacket disposed around the body member and having a wiper cup extending therefrom for engaging an inner surface of the casing, and an insert disposed across the central opening in the body member for at least temporary closure thereof. The insert is one of

a plurality of interchangeable inserts. These inserts include a shearable insert or disk adapted for shearing and thereby opening the central opening when a predetermined differential pressure is applied across the shearable insert and a substantially non-shearable insert or disk adapted for substantially permanent closure of the central opening. When the cementing plug is configured as a bottom plug, a shearable insert is used, and when the cementing plug is configured as a top plug, a non-shearable insert is used.

Each body member defines a recess adjacent to the central opening with an upwardly facing shoulder therein. When configuring the cementing plug as a bottom plug or a top plug, one of the inserts is disposed on the shoulder.

The invention may also be described as a cementing plug for use in cementing casing in a well, comprising a body member and an elastomeric jacket disposed around the body member with a wiper cup having a substantially conical outer surface thereon extending upwardly and outwardly at an acute angle with respect to a longitudinal axis of the plug. The conical surface deflects into substantially cylindrical, wiping engagement with an inner surface of the casing when the plug is disposed therein. This provides a large wiping surface for improved wiping and increased wear. Preferably, the wiper cup is one of a plurality of such wiper cups. As the upper wiper cup wears, the pressure will be gradually applied to the next lower wiper cup which continues the

wiping action. This also provides extended wear life.

Stated in another way, the invention is a cementing plug apparatus for use in cementing casing in a well. The apparatus comprises a first cementing plug and a second cementing plug.

The first cementing plug comprises a first body member defining a first central opening therethrough, a first jacket disposed on the first body member, and a replaceable first disk disposed adjacent to the first body member for temporarily closing the first central opening and subsequently shearing when subjected to a predetermined pressure, thereby opening the first central opening. The first jacket has a wiper cup extending therefrom adapted for wiping engagement with an inner surface of the casing.

The second cementing plug comprises a second body member defining a second central opening therethrough, a second jacket disposed on the second body member, and a replaceable second disk disposed adjacent to the second body member for substantially permanently closing the second central opening. The second jacket has a wiper cup extending therefrom adapted for wiping engagement with an inner surface of the casing.

In the preferred embodiment, the first and second body members are substantially identical, and the first and second jackets are substantially identical. The first and second disks are interchangeable. The first disk is a selected one

of a plurality of disks which are shearable at a corresponding plurality of predetermined pressures.

Also in the preferred embodiment, the first body member defines a first shoulder therein, and the second body member defines a second shoulder therein. The first disk is disposed on the first shoulder, and the second disk is disposed on the second shoulder.

Numerous objects and advantages of the invention will become apparent as the following detailed description of the preferred embodiments is read in conjunction with the drawings which illustrate such embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a first embodiment of the universal cementing plug and system of the present invention in use in a wellbore.

FIG. 2 is a perspective illustrating a first embodiment of a shearable insert used in the cementing plug as a bottom plug.

FIG. 3 illustrates in perspective a substantially non-shearable insert for use in the cementing plug as a top plug.

FIG. 4 illustrates a longitudinal cross section of the cementing plug of FIGS. 1-3.

FIG. 5 shows a second embodiment of the universal cementing plug and system of the present invention in use in a wellbore.

FIG. 6 is a perspective illustrating a second embodiment of a shearable insert used in the cementing plug as a bottom plug.

FIG. 7 is a longitudinal cross section of the second embodiment shearable insert.

FIG. 8 illustrates a longitudinal cross section of the cementing plug as a bottom plug including the second embodiment shearable insert of FIGS. 6 and 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and more particularly to FIG. 1, a first embodiment of the universal cementing plug of the present invention is shown and generally designated by the numeral 10. Universal cementing plug 10 may also be referred to as an improved wiping and/or extended wear cementing plug. As will be further discussed herein, cementing plug 10 can be configured as a first embodiment bottom plug 10' or a top plug 10". Bottom plug 10' and top plug 10" may be referred to together as a first embodiment cementing plug system.

Cementing plug 10 is designed for use in a casing 12 disposed in a wellbore 14. At the lower end of casing 12 is floating equipment, such as a casing float collar or float shoe 16, of a kind known in the art, having a valve 18 therein designed to allow cement to be pumped into an annulus 20 between casing 12 and wellbore 14 while preventing

backflow.

Referring now to FIGS. 2-3, the details of first embodiment cementing plug 10 will be discussed. Cementing plug 10 includes a plug subassembly 22 which comprises a body member 24 and a jacket 26 disposed around the body member. Body member 24 is made of any one of a number of drillable materials known in the art, such as aluminum, plastic, wood, etc. Jacket 26 is made of an elastomeric material and is molded onto the outer surface of body member 24.

Body member 24 has a substantially cylindrical configuration with an outer surface 28 and a central opening, such as a first bore 30, defined longitudinally therethrough. A larger second bore 32 is defined in the upper end of body member 24 such that an upwardly facing annular shoulder 34 is defined between first bore 30 and second bore 32. Thus, a recess is formed in the upper end of the central opening.

Jacket 26 has an upper radially outwardly extending lip 36 and a lower radially outwardly extending lip 38. Between upper lip 36 and lower lip 38 are a pair of upwardly opening cup portions 40 and 42. Cup portion 40 may be referred to as upper cup 40, and cup portion 42 may be referred to as lower cup 42. It will be seen that upper cup 40 and lower cup 42 extend upwardly and radially outwardly. As seen in FIG. 4, cups 40 and 42 extend at an acute angle with respect to a longitudinal axis of cementing plug 10, and thus are angled much more sharply with respect to body member 24 than are

upper lip 36 and lower lip 38. Upper cup 40 has an acutely angled conical outer surface 44 which is deflected into substantial wiping engagement with the inner surface of casing 12 as seen in FIG. 1, and lower cup 42 has a similar acutely angled conical surface 46.

FIG. 2 illustrates a first embodiment of a shearable insert or disk 48 which is substantially flat and of uniform thickness. FIG. 3 illustrates a substantially solid, non-shearable insert or disk 50 which is also substantially flat. Either of inserts 48 and 50 may be positioned on shoulder 34 in body member 24 of first embodiment cementing plug 10. Referring to the right side of FIG. 4, non-shearable insert 50 is shown thus forming a top plug 10". In the left side of FIG. 4, first embodiment shearable insert 48 is shown, thus illustrating a first embodiment bottom plug 10'.

First embodiment shearable insert 48 is made of a material which is easily sheared or ruptured when a predetermined differential pressure is applied thereacross. One typical material is rubber, but the invention is not intended to be so limited. The thickness of shearable insert 48 may be one of a plurality of available thicknesses so that the shear pressure may be predetermined as conditions dictate.

Non-shearable insert 50 is substantially thicker than shearable insert 48 and is designed to be substantially non-shearable when normal pressures are applied thereacross.

Thus, non-shearable insert 50 provides substantially permanent closure of the central opening in the corresponding body member 24.

Referring now to FIG. 5, a second embodiment of the uniform cementing plug of the present invention is shown and generally designated by the numeral 60. Universal cementing plug 60 may also be referred to as an improved wiping and/or extended-wear cementing plug. As will be further discussed herein, cementing plug 60 can be configured as a second embodiment bottom plug 60' or the same top plug 10" as in first embodiment cementing plug 10. Second embodiment bottom plug 60' and top plug 10" may be referred together as a second embodiment cementing plug system.

As with the first embodiment, second embodiment cementing plug 60 is designed for use in casing 12 disposed in wellbore 14. Again, at the lower end of casing 12 is floating equipment, such as casing float collar or float shoe 16 having valve 18 therein. An annulus 20 is formed between casing 12 and wellbore 14.

Referring now to FIGS. 6-8, the details of second embodiment cementing plug 60 will be discussed. Cementing plug 60 includes the same plug subassembly 22 used in first embodiment cementing plug 10. Therefore, the same reference numerals are used for the components of plug subassembly 22 in FIG. 8 as were used in FIG. 4 for the first embodiment. As with the first embodiment, in the second embodiment, upper

lip 40 on jacket 26 has an acutely angled conical outer surface 44 which is deflected into substantial wiping engagement with the inner surface of casing 12 as seen in FIG. 5, and lower cup 42 has a similar acutely angled conical surface 46.

FIGS. 6 and 7 illustrate a second embodiment of a shearable insert or member 62. Shearable insert 62 has an outer ring portion 64 and a relatively thin inner portion 66 which acts as a rupture disk portion. In the preferred embodiment, but not by way of limitation, inner portion 66 has an outwardly convex, curvilinear configuration. Thus, inner portion 66 may also be referred to as a domed portion 66.

Domed portion 66 is integrally formed with outer ring portion 64 and extends upwardly and inwardly from the ring portion.

Domed portion 66 preferably has a variable thickness including a first thickness X at or near its center and a second thickness Y adjacent to an internal corner 68 formed on the inside between ring portion 64 and domed portion 66. In the illustrated embodiment, first thickness X is less than second thickness Y. Corner 68 is preferably radiused.

EXAMPLES

Although various materials may be used for shearable insert 62, a preferred material is 23570 glass-filled plastic

from Barlow-Hunt, Inc., of Tulsa, Oklahoma. This material has a working temperature range of room temperature to about 410° F.

The following table illustrates the pressure at which domed portion 66 shears based on different values of X and Y using this material:

X	Y	Shear Pressure
0.100"	0.125"	370 psi
0.125"	0.150"	700 psi
0.131" - 0.135"	0.175"	1200 psi

In a preferred embodiment, but not by way of limitation, the height Z of domed portion 66 above ring portion 64 is approximately equal to center thickness X of domed portion 66.

Second embodiment shearable insert 62 may be positioned on shoulder 34 in body member 24 of plug subassembly 22 to form second embodiment bottom plug 60', as seen in FIGS. 5 and 8.

In second embodiment cementing plug 60, top plug 10" used with bottom plug 60' is identical to that in first embodiment cementing plug 10.

OPERATION OF THE INVENTION

Referring again to FIGS. 1 and 5, the operation of

cementing plug systems 10 and 60 are shown, respectively. First, a bottom plug 10' or 60' is prepared by positioning a shearable insert 48 or 62, respectively, in body member 24 of a plug subassembly 22, and a top plug 10" is similarly formed by positioning a non-shearable insert 50 in body member 24 of another plug subassembly 22. Bottom plug 10' or 60' is dropped into casing 12 in a manner known in the art. Cement 70 is pumped into casing 12 above bottom plug 10' or 60', thus forcing the bottom plug downwardly to displace mud and other fluid in casing volume 72 below bottom plug 10' or 60'. This mud is forced outwardly into well annulus 20 after opening of valve 18 in float shoe 16.

Once the desired amount of cement 70 is pumped into casing 12, top plug 10" is dropped into the well, and additional fluid pumped into casing 12 to force top plug 10" downwardly. The downward movement of top plug 10", forces cement 70 downwardly, and thus, bottom plug 10' or 60' is also forced downwardly until it lands on top of float shoe 16. Additional pressure applied above upper plug 10" will create a pressure differential across shearable insert 48 in bottom plug 10' or shearable insert 62 in bottom plug 60' until the insert shears. At this point, further pumping of fluid above top plug 10" will force cement downwardly through first bore 30 in body member 24 of lower plug 10' or 60' and past valve 18 in float shoe 16 so that the cement is pumped into well annulus 20. Pumping is stopped when top plug 10"

lands on top of bottom plug 10' or 60', at which point all of the cement has been forced into well annulus 20. Once the cement cures, top plug 10", bottom plug 10' or 60' and float shoe 16 may be drilled out of casing 12 as desired in a manner known in the art.

The sharply angled configuration of conical surfaces 44 and 46, respectively, of upper cup 40 and lower cup 42 on jacket 26 of bottom plug 10' or 60' and top plug 10" offers more surface contact with the inside of casing 12 than previous cementing plugs. When bottom plug 10' or 60' and top plug 10" are positioned in casing 12, conical surfaces 44 and 46 are compressed such that they are in flat, substantially cylindrical contact with the inner surface of the casing. As any of plugs 10', 60' or 10" move downwardly through casing 12, the pressure above the plug is first mostly applied to upper cup 40. As conical surface 44 wears and fluid pressure leaks therepast, the pressure is then applied to lower cup 42 and conical surface 46 thereof. Cementing plug 10 or 60 can be designed with any number of cup portions as well conditions dictate.

Because of the design of new cementing plug 10 or 60, the operator of the well only has to maintain one plug subassembly 22 in inventory, along with the necessary corresponding number of shearable inserts 48 or 62 and non-shearable inserts 50. Thus, inventory control is simpler than with prior art plugs. Further, by having a plurality of

different shearable plugs 48 or 62, the operator has the opportunity to select a shear pressure rather than use the single pressure previously available.

It will be seen, therefore, that the cementing plug of the present invention is well adapted to carry out the ends and advantages mentioned, as well as those inherent therein. While a preferred embodiment of the invention has been shown for the purposes of this disclosure, numerous changes in the arrangement and construction of parts may be made by those skilled in the art. All such changes are encompassed within the scope and spirit of the appended claims.

What is claimed is:

1. A cementing plug for use in cementing casing in a well, comprising:

a body member defining a central opening therethrough;

an elastomeric jacket disposed around said body member and having a wiper cup extending therefrom for engaging an inner surface of the casing; and

an insert disposed across said central opening in said body member for closure thereof, said insert being one of a plurality of interchangeable inserts.

2. The plug of claim 1 wherein said insert is a shearable member adapted for shearing and opening said central opening when a predetermined differential pressure is applied across said shearable member.

3. The plug of claim 2 wherein said shearable member is made of a rupturable material.

4. The plug of claim 2 wherein said shearable member is a substantially flat disk having a substantially uniform thickness.

5. The plug of claim 2 wherein said shearable member comprises:

a ring portion; and

a domed portion extending from said ring portion.

6. The plug of claim 1 wherein said insert is a substantially non-shearable ~~disk~~ adapted for substantially permanent closure of said central opening.

7. The plug of claim 1 wherein:

said body member defines a shoulder in said central opening; and

said insert is disposed on said shoulder.

8. The plug of claim 1 wherein said wiper cup is one of a plurality of such wiper cups.

9. The plug of claim 1 wherein said wiper cup has an conical outer surface extending upwardly and outwardly at an acute angle with respect to a longitudinal axis of the plug.

10. A cementing plug for use in a cementing casing in a well, comprising:

a body member having a longitudinal axis; and

an elastomeric jacket disposed around said body member and having a wiper cup extending therefrom, said wiper cup defining a conical outer surface extending upwardly and outwardly at an acute angle with respect to said longitudinal axis, wherein said outer surface is deflected into substantially cylindrical, wiping engagement with an inner surface of a casing when the plug is disposed therein.

11. The plug of claim 10 wherein said wiper cup is one of a plurality of said wiper cups.

12. The apparatus of claim 10 wherein said body member defines a central opening therethrough; and

further comprising an insert disposed in said central opening for at least temporary closure thereof, said insert being a selected one of a plurality of inserts.

13. The plug of claim 12 wherein said plurality of inserts comprises a shearable insert and a substantially non-shearable insert.

14. The plug of claim 12 wherein said insert is positioned on a shoulder defined on said body member.

15. A cementing plug apparatus for use in cementing a length of well casing in a well, said apparatus comprising:

a pair of substantially identical plug subassemblies, each of said plug subassemblies comprising:

a generally cylindrical body member defining a central opening longitudinally therethrough; and

an outer jacket disposed around said body member, said jacket having a resilient wiper cup extending therefrom adapted for wiping engagement with an inner surface of said length of casing;

a shearable insert positionable in one of said body members for temporarily closing said central opening in said one body member and for rupturing and thereby opening said central opening in response to a predetermined differential pressure thereacross; and

a substantially non-shearable insert positionable in the other of said body members for substantially permanently closing said central opening in the other body member.

16. The apparatus of claim 15 wherein said jacket is made of an elastomeric material.

17. The apparatus of claim 15 wherein said wiper cup is one of a plurality of wiper cups extending from said jacket.

18. The apparatus of claim 15 wherein said wiper cup has an outer surface extending upwardly and outwardly at an acute angle with respect to a longitudinal axis of the corresponding body member.

19. The apparatus of claim 15 wherein:

said body member has a recess defined therein adjacent to said central opening;

said shearable insert is positioned in the recess of said one of said plugs; and

said non-shearable insert is positioned in the recess of the other of said plugs.

20. The apparatus of claim 15 wherein said shearable insert comprises:

a ring portion; and

a domed portion extending upwardly and inwardly from said outer ring portion.

21. The apparatus of claim 15 wherein said shearable insert comprises a substantially flat disk of substantially uniform thickness.

22. The apparatus of claim 15 wherein said non-shearable insert comprises a substantially flat disk of substantially uniform thickness.

23. A cementing plug apparatus for use in cementing casing in a well, said apparatus comprising:

a first cementing plug comprising:

a first body member defining a first central opening therethrough;

a first jacket disposed on said first body member, said first jacket having a wiper cup extending therefrom adapted for wiping engagement with an inner surface of the casing; and

a replaceable first insert disposed adjacent to said first body member for temporarily closing said first central opening and subsequently shearing when subjected to a predetermined pressure, thereby opening said first central opening; and

a second cementing plug comprising:

a second body member defining a second central opening therethrough;

a second jacket disposed on said second body member, said second jacket having a wiper cup extending therefrom adapted for wiping engagement with an inner surface of the casing; and

a replaceable second insert disposed adjacent to said second body member for substantially permanently closing said second central opening.

24. The apparatus of claim 23 wherein:

said first and second body members are substantially identical; and

said first and second jackets are substantially identical.

25. The apparatus of claim 23 wherein said first and second inserts are interchangeable.

26. The apparatus of claim 23 wherein said first insert is a selected one of a plurality of inserts shearable at a corresponding plurality of predetermined pressures.

27. The apparatus of claim 26 wherein said first insert comprises a substantially flat disk.

28. The apparatus of claim 26 wherein said first insert comprises:

an outer ring portion; and

an inner domed portion integrally formed with said outer ring portion.

29. The apparatus of claim 24 wherein said second insert comprises a substantially flat disk.

30. The apparatus of claim 23 wherein said first and second jackets are made of an elastomeric material.

31. The apparatus of claim 23 wherein:

said wiper cup on said first jacket is one of a pair of wiper cups; and

said second wiper cup on said second jacket is one of a pair of wiper cups.

32. The apparatus of claim 23 wherein said wiper cup on said first jacket and said wiper cup on said second jacket have a conical outer surface extending upwardly and outwardly at an acute angle with respect to a longitudinal axis of said first and second body members.

33. The apparatus of claim 32 wherein said wiper cups are made of an elastomeric material.

34. The apparatus of claim 23 wherein:

said first body member defines a first shoulder therein;

said second body member defines a second shoulder therein;

said first disk is disposed on said first shoulder; and

said second disk is disposed on said second shoulder.

35. An insert for use in a cementing plug, said insert comprising:

an outer ring portion; and

an inner portion extending from said outer portion, said inner portion being thinner than said outer ring portion.

36. The insert of claim 35 wherein said ring portion and said inner portion are integrally formed.

37. The insert of claim 35 wherein said ring portion and said inner portion form an internal corner.

38. The insert of claim 37 wherein said corner is radiused.

39. The insert of claim 35 wherein said inner portion has a variable thickness.

40. The insert of claim 39 wherein said inner portion has a first thickness at a center thereof and a second thickness at an outer portion thereof adjacent to said ring portion.

41. The insert of claim 40 wherein said inner portion is an outwardly convex domed portion.

42. The insert of claim 41 wherein said domed portion has a height above said ring portion approximately equal to said first thickness.

43. The insert of claim 40 wherein said first thickness is less than said second thickness.

ABSTRACT OF THE DISCLOSURE

A cementing plug having a universal construction and improved wiping and extended wear characteristics. The cementing plug has a plug subassembly with a body member and an elastomeric jacket on the body member. The body member defines a central opening therethrough with a shoulder therein. To configure the plug as a bottom cementing plug, a shearable insert is positioned on the shoulder, and to configure the plug as a top cementing plug, a non-shearable insert is positioned on the shoulder. The shearable insert is one of a plurality of such inserts designed to shear at correspondingly different shear pressures. In a first embodiment, the shearable insert is a substantially flat disk having a uniform thickness, and in a second embodiment, the shearable insert has an outer ring portion and a relatively thin inner domed portion. Thus, a bottom plug may be pumped down a well casing with cement and a top plug thereabove so that when the bottom plug lands at the bottom of the casing, the shearable insert will shear at the predetermined pressure. The jacket has one or more wiper cups which have a conical surface extending at an acute angle with respect to a longitudinal axis of the plug, thereby providing a substantially large contact area in the well casing to improve wiping efficiency and extend life.

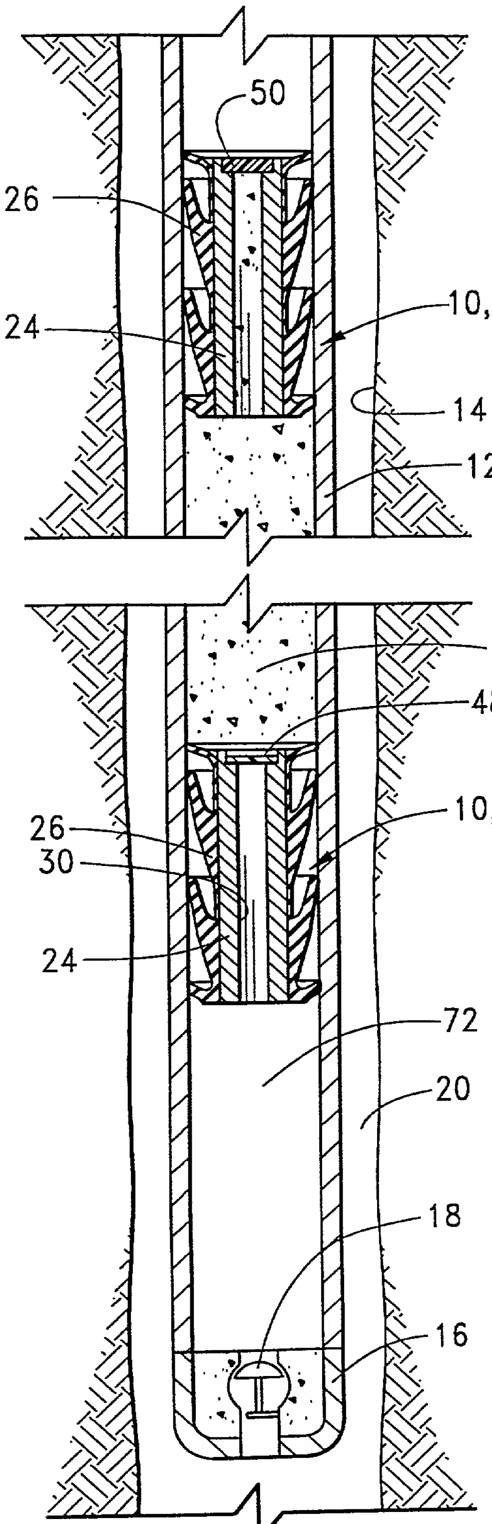

FIG-1

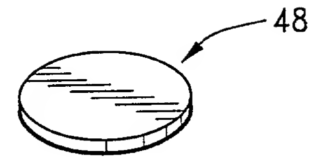

FIG-2

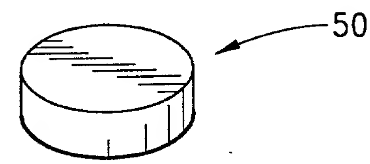

FIG-3

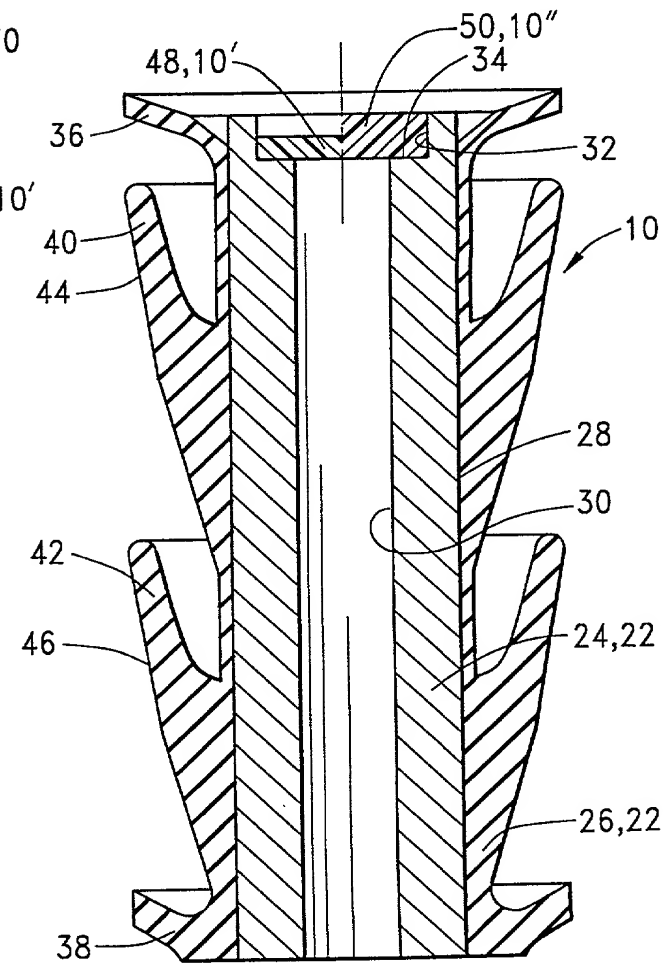

FIG-4

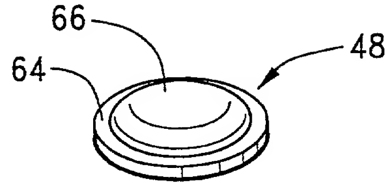

FIG-6

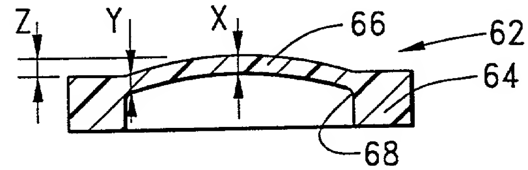

FIG-7

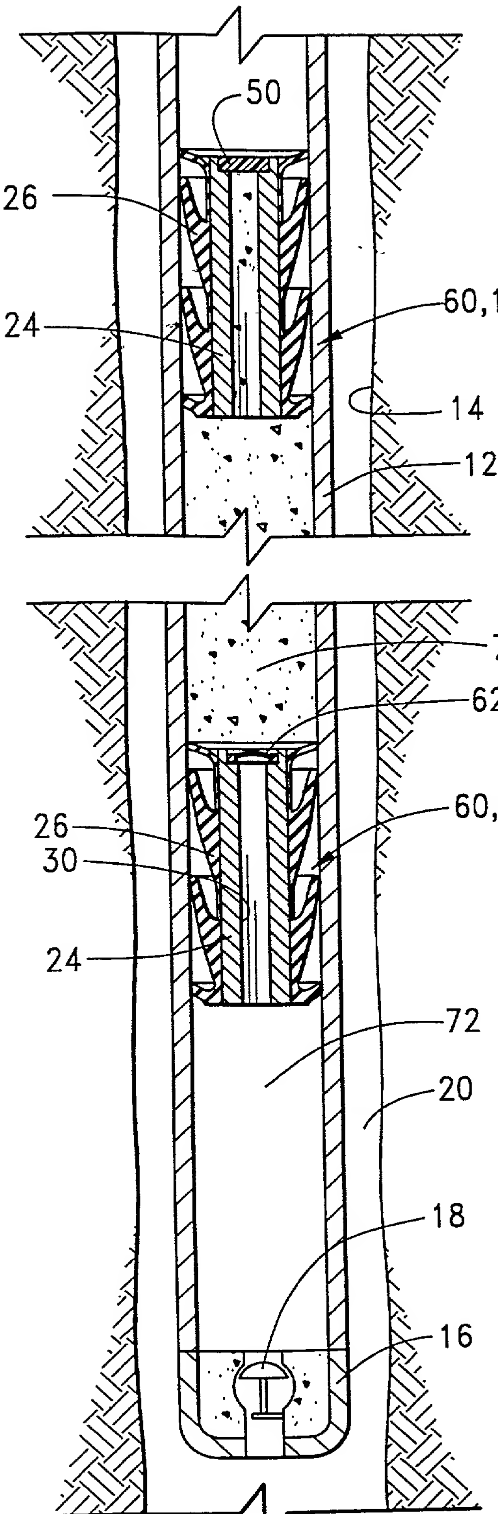

FIG-5

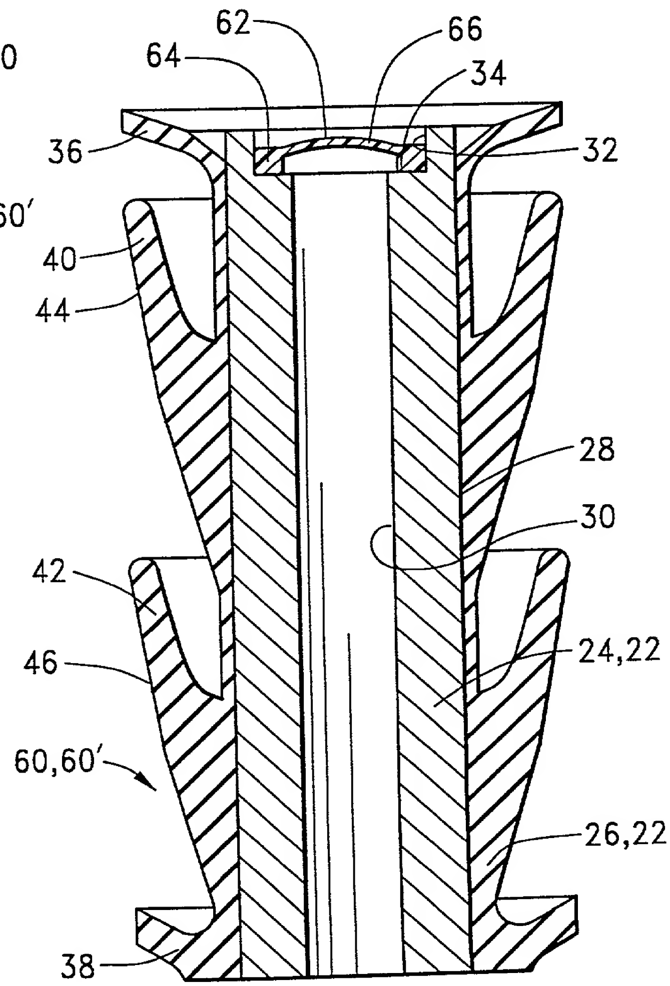

FIG-8

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing **OR** ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	HES 98.0078U1
First Named Inventor	Harold O. Treece
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Universal Cementing Plug

(Title of the Invention)

the specification of which
☒ is attached hereto
OR
☐ was filed on (MM/DD/YYYY) _____ as United States Application Number or PCT International Application Number _____ and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
none			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)
none	

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*
none		

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As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number [ ] → *Place Customer Number Bar Code Label here*
OR
☒ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
Craig W. Roddy	36,256		

☒ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Harold O.	Treece

Inventor's Signature	Harold O. Treece					**Date**	10/20/98
Residence: City	Duncan	**State**	OK	**Country**	U.S.	**Citizenship**	U.S.
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City	Duncan	**State**	OK	**ZIP**	73533	**Country**	U.S.

☐ Additional inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION

REGISTERED PRACTITIONER INFORMATION (Supplemental Sheet)

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Eugene R. Montalvo	32,790	Michael J. LaBrie	39,507
Craig W. Roddy	36,256	Anthony L. Rahhal	37,562
William E. Shull	29,438		

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